Airport & Aircraft Safety R&D Notes

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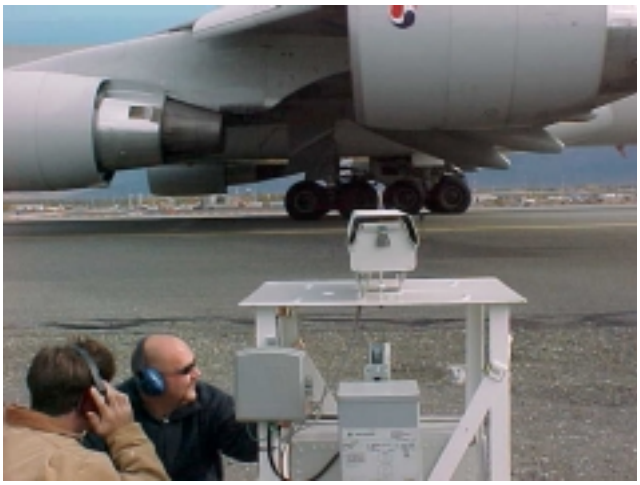
Taxiway Centerline Deviation Study

Preliminary research into the compatibility of New Large Aircraft (Group VI standards) and existing taxiway networks (Group V standards) has shown that on many taxiway routes New Large Aircraft wingtips will intrude into the safety areas of adjacent taxiways, runways, and terminal areas. Group VI standards call for increasing both taxiway widths and centerline-to-centerline separations from the current Group V standards.



LASER Rangefinder detecting distance of main gear on a B-747 from the taxiway center

It must be determined what, if any, changes to Group VI standards should be made before the introduction of New Large Aircraft. In order to make these decisions, data must be collected and analyzed. It has been determined that collecting data on the deviation from taxiway centerline for Boeing 747s will provide the information necessary to make that decision. The methodology employed in this study uses these deviations from centerline of taxiing Boeing 747 airplanes along with a statistical analysis of these deviations to estimate probabilities of airplane contact.

Anchorage International Airport was chosen as the logical airport due to its large number of B-747 traffic and availability of varying weather conditions. Personnel of the Airport Technology R&D Branch, AAR-410, successfully completed the installation of the

LASER Rangefinder at Anchorage International Airport

taxiway centerline deviation system at Anchorage International Airport during the week of September 18, 2000. Each system consist of two laser rangefinders, a computer with appropriate software, associated structural stands to mount the equipment to the proper height, and associated infrastructure of concrete foundations, and power and data collection

INSIDE THIS ISSUE

1	Taxiway Centerline Deviation Study
2	Second Workshop on Risk Analysis and Safety Performance Measurement in Aviation
3	Material Fire Tests Working Group Meeting
4	FAA AANC Notes
6	Centers of Excellence Announcements
6	Joint R&D Project Agreement With China Signed
7	In Brief
8	Personnel Notes

cables. There are two systems in place that will account for 90% of the B-747 traffic.

The final installation was the culmination of nearly a one-year effort to select the appropriate locations on the taxiways, coordinate and install required infrastructure, develop specific software, acquire the necessary measurement equipment, and design and build structural stands. Data from this installation will be gathered over the next year.

Peter Sparacino, AAR-410, (609) 485-5430

Second Workshop on Risk Analysis and Safety Performance Measurement in Aviation

The Second Workshop on Risk Analysis and Safety Performance Measurement in Aviation was held on August 22 through 24 at the Federal Aviation Administration's William J. Hughes Technical Center, Atlantic City, NJ. The workshop was jointly sponsored by the FAA's Risk Analysis Section (AAR-424) and Rutgers University. The focus of this effort was primarily knowledge sharing of philosophies, approaches, models, and methodologies among Part 121 air carriers. Participants discussed their approaches to risk management and safety performance measurement. System models, hazard or threat analysis techniques, accident/incident models, and vulnerability analysis approaches were shared by the participants. Threats and defenses were identified in the models as well as safety critical functions.

Two pre workshop tutorials on Risk Management and Safety Performance Measurements kicked off the two and a half days of workshops. These issues were discussed by representatives from Rutgers University, Transport Canada, and Massachusetts Institute of Technology.

Rosanne Weiss (standing), AAR-424 with Rutgers University Industrial Engineering Students

The actual workshops began with the keynote speaker, Mr. Jim Burnett, former chair of the National Transportation Safety Board. Mr. Burnett's presentation raised many questions from the audience.

Workshop speakers were from Atlas Air, Jet Blue Airways, United Airlines, Northwest Airlines, Airborne Express, the US Coast Guard, Marines, Navy, Army, Air Force, Scandinavian Airlines, Aer Lingus, Air Canada, the Boeing Company, the FAA, Rutgers University, and Sandia National Laboratories.

There were more than 180 attendees not only from the US but also from Canada, Cambodia, Austria, Chile, Brazil, England, Ireland, Spain, The Netherlands, Taiwan, United Arab Emirates, and South Africa. Attendees were from the civilian sector as well as from the military sector.

Kathy Fazen, AAR-424, gave a presentation entitled "FAA R, E, &D Activities in Support of a System Safety Approach to Aviation Oversight." She explained the mission of the Risk Analysis Section, AAR-424, and discussed the objective of the Risk Management Decision Support Project. In addition, she

covered the Air Carrier Operations System Model (ACOSM). The objective of ACOSM is to develop a system engineering model to be used in the development of performance measures and risk indicators and to provide a common definition of air carrier processes and terminology to promote understanding of air carrier operational activities and functions. Fazen explained the requirements of the model and identified the participants. She also described the Markov Latent Effects Tool that will be used for Safety Risk Modeling and the components of the Analysis Concept Development effort and provided a breakdown of efforts for the fiscal year.

Dr. Hossein Eghbali, Hi-Tec Systems, presented his research, which is funded by the FAA, entitled "Empirical Bayes Estimate (EBE) of Engine In-Flight Shutdown Rate." Hossein defined the problem and explained the use of EBE to identify trends in engine shut down rates over time. He presented graphs showing that EBE was a much better estimate than the Maximum Likelihood Estimate (MLE) of Engine In-Flight Shutdown Rate.

Some of the other topics covered were:

- Flight Crew Reporting Systems and Incident Reports
- Risk Analysis: Human Factors and Organization
- Application of Risk Management Principles to Airline Operations
- Safety Information Management System
- Aviation Safety Risk Modeling, Assessment and Management
- Failure Modes, Effects, and Criticality Analysis of Air Carrier Operations
- Combined Deviation Reporting System
- Safety Performance Measurement at Air Canada
- Proactive Measures of Corporate Safety Performance
- Squadron Assistance/Risk Assessment
- Navy Safety Culture Assessment
- Operational Risk Management: Risk Assessment
- Army Aviation Safety Investment Strategy
- Airplane Safety Risk Assessment in the New Millennium

Attendees were afforded an opportunity to interact with the presenters during breaks and at a reception held the second evening. Attendees were also given a tour of four of the Technical Center's research and development facilities: the Dynamic Vertical Drop Test Facility, the Fire Safety Research Facility, the Airflow Induction Test Facility, and the National Airport Pavement Test Facility.

Rosanne Weiss, AAR-424, (609) 485-4370

Material Fire Tests Working Group Meeting

The International Aircraft Material Fire Tests Working Group, chaired by Dick Hill, AAR-422, and administered by AAR-422, met in Atlantic City on September 13 - 14. The purpose of the working group is to develop new material fire tests or improve existing required fire test standards. It is comprised of representatives from the international aviation community, primarily industry, and the regulatory authorities and other government agencies. Meetings are held fairly frequently, usually three times a year, to work on improved material fire tests. Approximately 90 people attended this particular meeting, although group participants number about 500.

The primary subject matter presented and discussed at the meeting was the new flammability tests for thermal acoustic insulation. A pending Notice of Proposed Rulemaking (NPRM) on insulation flammability, which was issued the following week (Federal Register, Vol. 65, No. 183, September 20, 2000, pp 56992-57009), provided the incentive for the priority given to the new fire tests. The NPRM proposes separate improved fire tests for in-flight fire ignition resistance and postcrash fire burnthrough resistance.

A majority of the presentations were made by AAR-422 personnel. Pat Cahill and Tim Marker gave status reports on the radiant panel (ignition resistance) and burnthrough test methods. Both tests are being modified to improve the consistency of test results while retaining the impact of the tests on which materials pass and fail. Round robin tests are planned (radiant panel) or are underway (burnthough), involving working group laboratories, to measure the repeatability (within lab) and reproducibility (between labs) of test results.

Test Method to Determine the Burnthrough Resistance of Thermal/Acoustic Insulation Materials

Although the meeting was dominated by insulation flammability discussions and presentations, there were several interesting subjects on the agenda. Dick Johnson described his experience with the care and calibration of heat flux transducers, important devices used to set the level of radiant heat impinging on the test specimen. Bob Filipczak presented the development of a slug calorimeter, which can be used to independently check the calibration of a heat flux transducer. His work was recently published (DOT/FAA/AR-TN00/38). Perhaps the most entertaining (and impressive) presentation was made by Rich Lyon. He described a new class of ultra-fire resistant polymers developed under his long-range Fire-Resistance Materials Program.

A breakout session allowed for task group meetings. The Potential Fire Threats Task Group has begun to work on upgrading the test criteria for all materials located in hidden areas (e.g., electrical wiring) to the same level proposed by the FAA for thermal acoustic insulation. This is a significant assignment which was recently highlighted and given a top priority by the Fire Safety Technical Community Representation Group (TCRG).

After the meeting adjoined, a number of participants stayed to meet one-on-one with AAR-422 personnel or to tour the fire test facilities. The next meeting of the working group will be hosted by Transport Canada in Ottawa on February 13-14, 2001.

Gus Sarkos, AAR-422, (609) 485-5620

FAA-AANC NOTES

Detection of Corrosion in Faying Surfaces Structured Experiment — Federal Aviation Administration Airworthiness Assurance NDI Validation Center (AANC) is implementing this experiment to identify and evaluate systems having the potential to find and quantify hidden corrosion in faying surfaces. Initially, over 60 potential participants were identified. To date, seven participants (airlines, original equipment manufacturers, nondestructive evaluation equipment manufacturers, universities, etc.) have participated in the experiment performing 11 separate inspections of the test specimens using a variety of ultrasonic and

eddy-current techniques. Two additional participants are scheduled to perform radiographic inspections. An initial analysis and report on experiment results is scheduled for April 2001.

Mike Ashbaugh, AANC, (505) 843-8722

Interlayer Crack Study — The Boeing Commercial Airplane Group and the FAA-AANC are currently completing a study pertaining to detection of cracks in multi layer aluminum sheets. The goal of this project is to derive reliability curves which will aid both aircraft OEM's and commercial airline companies in developing inspection processes for third layer cracks. The reliability curves will help the NDI community in understanding the inherent capabilities of the instrument and probes used in their interlayer crack inspections. Inspection results from 56 independent sliding probe eddy-current inspections taken at eight different maintenance facilities were presented at the Seattle FAA Certification Office, Boeing Commercial Airplane Group – Renton, WA, and the 44th Annual Air Transport Association (ATA) Nondestructive Testing (NDT) Forum in San Francisco, California. The data gathered during the experiments clearly reveal that a traditional two-parameter binary regression model provides an inadequate fit to individual inspection results. A generalization using four-parameters was used to capture inspection behaviors that results in hits, independent of crack length, that are made at sites containing small cracks and misses that are independent of crack length and are made at sites containing large cracks. In none of the cases was the parameter addressing misses at large cracks statistically significant. However the data from many of the individual inspections indicated that procedures and processes were being followed that resulted in random finds for the smaller cracks, rather than having a detection rate depending on crack length. A final report is being prepared and will be distributed throughout the aircraft industry.

Floyd Spencer, AANC, (505) 844-5647 and David Moore, AANC, (505) 844-7095

Completion of DC-10 Composite Doubler Repairs — The FAA-AANC installed composite doubler repairs on two DC-10 aircraft in the FedEx fleet. These are the first two of five to ten skin repairs that will be installed during the course of the DC-10/MD-11 project. Over the next year, these repairs will be closely monitored by FedEx and FAA-AANC inspections in order to compile a track record of the doubler's performance. This will allow the FAA and Boeing to gain confidence in the composite doubler repair process. It is hoped that this activity will ultimately lead to a Structural Repair Manual procedure. Fuselage impact damage was repaired on the DC-10 aircraft in the areas shown in Figures 1 and 2. One goal of the project is to demonstrate that aircraft maintenance personnel can be trained to install and inspect composite doublers. As a result, workers from FedEx's composite and NDT shops were essential participants in the repairs. The FAA-AANC will gradually reduce its role in the composite doubler installations until FedEx personnel are able to safely apply and inspect them without supervision. Pitch-catch ultrasonic inspections were conducted on both doublers (see Figure 3). No flaws were found

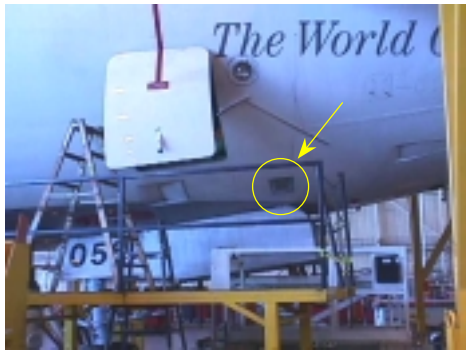


Figure 1: Repair Location on Aircraft 056 Adjacent to Nose Gear

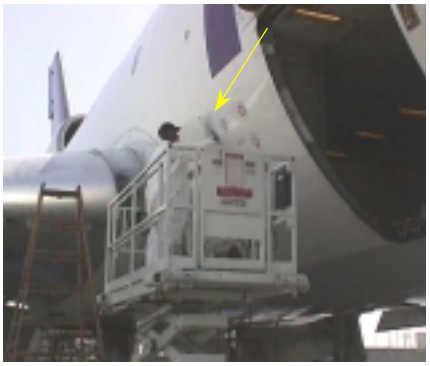


Figure 2: Repair Location on Aircraft 058 Right Side Forward of Wing

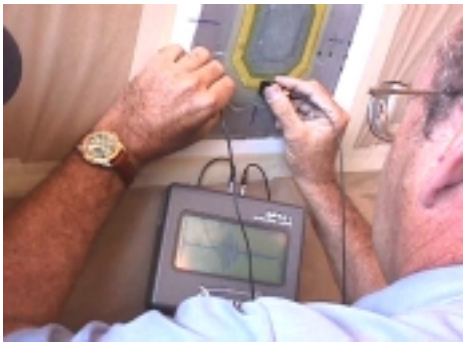


Figure 3: Pitch-Catch Ultrasonic Inspection of Composite Doubler

and the aircraft were returned to service.

Dennis Roach, AANC, (505) 844-6078

NDI Capability/Engine Component Inspection Validation — A series of test specimens have been acquired and used to investigate and validate NDI techniques and equipment for inspecting engine components. The specimens include actual aircraft parts, as well as manufactured specimens that contain representative engineered flaws. Experiments were conducted on a set of Allied Signal turbine disks, a set of two Pratt & Whitney 1-2 spool disks and six Pratt & Whitney third stage compressor disks, and a single GE stage two fan disk. Another significant focus of this program involved activities with JENTEK Sensors, Inc. The FAA-AANC obtained a JENTEK Meandering Winding Magnetometer (MWM™) and GridStation™ Measurement System Inspection Station for engine disk slot inspections. Three AANC engineers participated in a preliminary capability assessment to find cracks in several f110 second stage disks. Another similar assessment is to be completed by the AANC in the fall of this year using this system at Tinker Air Force Base. Other participants who are scheduled to participate in engine component inspection assessments include RD Tech with their eddy-current array probe and Olympus with their boroscopic stereo measurement system.

Mike Bode, AANC, (505) 843-8722

FAA Centers of Excellence Announcements

The Center of Excellence (COE) for Airworthiness Assurance (AACE) is highlighting Phase I research results at a major symposium being co-hosted by the Boeing Company and the FAA Northwest Mountain Region. The symposium is being held at the Boeing conference facility in Seattle, WA, November 14-16. Details and registration forms are available on the AACE website: www.aace.ohio-state.edu or by contacting Catherine Bigelow, FAA AACE Program Manager, AAR-430, telephone: (609) 485-6662.

The COE for Operations Research (NEXTOR) is holding an Annual Meeting at FAA Headquarters on November 14 in the Auditorium. A closed session of the Steering Committee will follow on November 15 at Virginia Polytechnic Institute, Falls Church, VA, campus. The agenda for the annual meeting is available for distribution. Those interested may contact Lewis Fisher, ASD-430, (202) 358-5525.

The COE for General Aviation solicitation is open through December 1, 2000. Information and copies of the announcement are available for distribution. Contact David Nesterok, (609) 485-4042.

Patricia Watts, AAR-400, 609-485-5043

Joint R&D Project Agreement With China Signed

The Federal Aviation Administration has signed a Joint Research and Development (R&D) Project agreement with the General Administration of Civil Aviation of China (CAAC). A signing ceremony was held September 15 in Beijing, China. Assistant Administrator for Policy Planning and International Aviation, Mr. David Traynham, and Associate Administrator for Regulation and Certification, Mr. Thomas McSweeny, of the FAA attended the ceremony in Beijing. Mr. Traynham of the FAA and Vice Minister of the CAAC, Yang Yuan Yuan, signed the agreement at the ceremony.

This Joint R&D Project agreement is an annex (Annex 8) to the Memorandum of Agreement for Technical Cooperation in the Field of Civil Aviation (AIA/CA-32) between the FAA and the CAAC. Under Annex 8,

the FAA and the CAAC will conduct joint R&D projects in aircraft safety and airworthiness assurance to include the exchange of information, joint testing and analysis, coordination of shared R&D activities, exchange of technical staff, and joint organization of symposia and conferences. This is the first time that a formal agreement on joint R&D efforts has been signed between the FAA and the CAAC.
As the first joint research effort, an appendix (Appendix 1) to Annex 8 was also signed at the signing ceremony on September 15 in Beijing, China. Appendix 1 allows the FAA and the CAAC to conduct joint research on crack initiation. The CAAC Aircraft Safety Technology Center (ASTC) will be performing an experimental study on crack initiation in aircraft structural skins under cyclic loading. Twenty-two single-edge notch specimens are to be tested under different cyclic loading conditions. Fractographic analyses using a scanning electron microscope (SEM) will be used to study details of crack initiation and growth. Test results from this study will support the FAA's research efforts on the evaluation of widespread fatigue damage. The project under Appendix 1 will be completed within six months.
It is anticipated that, under Annex 8, the FAA and the CAAC will continue joint R&D efforts in aviation safety and continued airworthiness assurance.

Xiaogong Lee, AAR-431, (609) 485-6967

In Brief

FAA Electromagnetic Research Review. The FAA Electromagnetic Hazards team consisting of FAA technical personnel, the FAA sponsor, an FAA NRS, and various FAA certification personnel met recently in Denver to update their research plan. The discussions revolved around the electromagnetic hazards tasks, which are based on the current Electromagnetic Hazards to Aircraft and Systems (EHAS) research plan. This plan identifies 18 potential research tasks. The FAA team meets several times a year to discuss program status, funding, and future FAA research.

Anthony Wilson, AAR-421, (609) 485-4500

FAA Airport Pavement Working Group Meeting. Researchers from the FAA, the Boeing Company, Airbus, the French Civil Aviation, and a host of other organizations from around the world met for two days, September 14-15, at the FAA William J. Hughes Technical Center to hear testing updates and the results from the National Airport Pavement Test Machine. The common goal of the working group is to confirm the compatibility between the new, heavy aircraft like the Boeing B-777 and the Airbus A-3XX with the existing airports around the world. The test results from the FAA facility are very encouraging; however, the results cannot be finalized for use in FAA standards until the remaining pavements also fail and a complete examination of the pavement structures is made during demolition. Demolition and reconstruction of the pavement section for the next series of testing is scheduled to start December 1, 2000.

Satish K. Agrawal, AAR-410, (609) 485-6686

Jet Blast Test Platform. Harry Webster, Jack Berry (both AAR-422), Jim White (AAR-411) and Engineered Systems Company completed construction of a test platform at the exhaust end of the induction wind tunnel (Building 204). The raised platform allows placement of test articles in jet blast zones with very high wind speeds, temperatures, and sound pressure waves. Cellular cement arrestor systems will be tested on this platform in late October 2000.

Paul Jones, AAR-411, (609) 485-6713

Airport Pavement Marking Evaluation. The Airport Safety Technology Section (AAR-411) is evaluating variations of runway and Instrument Landing System holding position markings to assist in the revision of AC 150/5340-1H Standards for Airport Marking. Project Manager Holly Cyrus, AAR-411, placed 16 different size options at the Atlantic City International Airport for evaluation. The project supports one of the Administrator's top ten initiatives for reducing runway incursions.

Paul Jones, AAR-411, (609) 485-6713

Uncontained Engine Debris Damage Assessment Model (UEDDAM). The US Air Force C-5 Program has requested and received a copy of the UEDDAM developed by the Naval Air Warfare Center (NAWC), China Lake, in support of the Aircraft Catastrophic Failure Prevention Program. The model will be evaluated by the Air Force as part of the C-5 Reliability Enhancement and Re-Engining Program (RERP). The evaluation will be used as part of the beta evaluation of the code. The Air Force will provide written comments to NAWC on their evaluation of the usefulness of the tool, including documentation of any problems encountered.

William Emmerling, AAR-432, (609) 485-4009

Fourth FAA Uncontainment Proceedings. Proceedings of the Fourth FAA Uncontained Engine Debris Characterization Modeling and Mitigation Workshop have been distributed on CD ROM to the participants by the workshop host, SRI International. Presentations with an attendance list are provided in Adobe Acrobat format. Simulations and test movies are provided in both .avi and .mov format. Requests for additional copies can be made to Don Altobelli, AAR-432, (609) 485-5940.

William Emmerling, AAR-432, (609) 485-4009

Personnel Notes

Richard Hill, AAR-422, received a Special Achievement Award for his efforts to respond to National Transportation Safety Board (NTSB) recommendations arising out of the TWA 800 incident.

Joseph Wright, AAR-410, has retired from the FAA after over 30 years of government service. Joe most recently was working with the Airport Rescue and Firefighting Program.

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Airport & Aircraft Safety R&D Notes is published quarterly. If you have any questions about this issue, or have ideas for future articles, please contact the editor, Jim Lignugaris, at (609) 485-4431 or via email at jim.lignugaris@tc.faa.gov.